AUGUST 1961

Soil Conservation

SOIL CONSERVATION SERVICE • U. S. DEPARTMENT OF AGRICULTURE

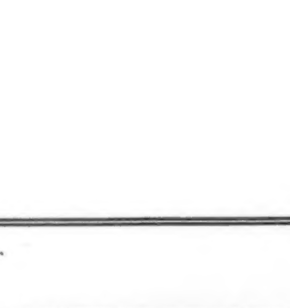
UNITED STATES DEPARTMENT OF AGRICULTURE

1862 1962

Growth Through Agricultural Progress

"Our Nation has been blessed with a bountiful supply of water; but it is not a blessing we can regard with complacency."

—JOHN F. KENNEDY



COVER PICTURE.—Springs have been an important source of stockwater in the West ever since stockmen trailed their first herds across the Great Plains. This is a typical present-day conservation spring development, on the Ulrich ranch near Johnson City, Tex.

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Soil Conservation

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Water Conservation

By Donald A. Williams

WATER commands the attention of resource conservationists today as never before. Mounting demands all over the country force communities and industries to seek new water sources. Droughts and floods create local emergencies.

The public is aroused to water problems in the nineteen-sixties much as it was to the menace of soil erosion in the thirties.

Water conservation is a major responsibility of the Soil Conservation Service. From the beginning, water conservation has been associated with soil conservation. The basic Soil Conservation Act of 1935 (Public Law 46) recognized "the wastage of soil *and moisture* resources" and provided "for the control and prevention of soil erosion and thereby to preserve natural resources, control floods, prevent impairment of reservoirs, and maintain the navigability of rivers and harbors . . ."

Although the primary attention of the Service, and of soil conservation districts, in the early years was directed at erosion control, its program has expanded to include a broad range of soil and water management activities. Many soil conservation districts are revising their programs, too, and even changing their names, to show their growing concern with water conservation. Water management in conjunction with soil and cover management is the primary purpose of small-watershed projects.

Water conservation takes many forms, but everywhere it is basic to conserving soil. It begins with holding water on and in the soil in accordance with the natural capabilities of the land, then disposing in orderly fashion of any excess water into natural channels.

"Banking" water in the soil for later use by crops is fundamental to conservation accomplishment in many areas of the country. In others the primary consideration is managing the land and its cover to avoid wasteful consumptive uses or evaporation losses in water-producing areas. Efficient and beneficial use of water on irrigated land through proper control of moisture in relation to soils and plants is water conservation also.

In all these circumstances, soil conservation and water conservation are intimately interrelated. And water conservation, like soil conservation, requires a combination of technologies to cope with the peculiar problems of each situation.

Such maladjustments as too little water or too much, water at the wrong time or wrong place, and such questions as how much there is likely to be and to whom it belongs—these and others, ad infinitum, must be dealt with day by day by trained conservationists in the localities where they occur.

The Soil Conservation Service deals with these matters as a regular part of its operations on the land. From the snow surveys in the high mountains to water control programs in the coastal plains and river deltas, the SCS helps landowners and water users make efficient use of the available supply under prevailing local conditions. In every part of the country, soil surveys provide fundamental information for managing moisture in the soil and for planning water-control structures. SCS hydrologists, conservation engineers, and other specialists help design irrigation systems, floodwater-retarding dams, ponds and reservoirs, and many other water conservation measures.

While the country is in no imminent danger of running out of water, it simply is no longer in the enviable position of having enough water at all times for all uses at all locations. In many places there must be choices among alternative uses for the available supply. Economic developments in many cases will have to go where the required water is. On a national scale, we shall have to take effective action to regulate and stabilize streamflow, to develop water resources, and to protect them from pollution and sedimentation.

Teamwork and cooperative effort of local, State, and Federal interests have pointed the way in soil conservation. Water problems will be solved by the same kind of joint effort. Tremendous progress already is being made in soil conservation districts and watershed projects across the country.

Everywhere, farmers, ranchers, and town and city people in business and industry—in fact, everyone who uses water in any way—are affected by what the Soil Conservation Service is doing to conserve soil and water. Our role is fundamental, for it approaches water conservation on the basic relationship of land, water, and people.

One Drop of Water Does Work of Two

By R. S. Swenson

MAKING one drop of water do the work of two is a must for farmers in the Eloy and Seven-Eight soil conservation districts of southern Arizona.

A part of the great Sonoran Desert, the districts are in the lower Santa Cruz Valley between Tucson and Casa Grande. Rainfall averages about 8 inches a year, falling mostly as severe downpours during July and August or as more gentle rains in December and January.

Little of the rainfall has any value for growing crops. Farmers have to depend entirely on deep, drilled wells for irrigation water, except for a few who pick up surface water from the Santa Cruz River, normally a dry stream. Some wells are 2,000 feet deep or deeper, with an average pump lift of nearly 400 feet. Water levels have been dropping steadily each year.

Cotton is the main crop in the area, being one of the few crops that can be grown at a profit today. Other crops include alfalfa, sorghum, barley, wheat, and vegetables. The average cotton yield for 1957 was 2.4 bales an acre, and slightly less than that over the 5 years to 1960.

All of Thompson's forage and grain is fed to livestock like these yearlings he is admiring.

One of the big problems is the declining water supply. A combination of an annually lower water table from pumping and a decreased yield of water from the wells has left farmers with about 50 percent as much water as they had in 1949. They long have recognized the need for using soil and water conservation practices if they are to stay in business.

In 1945 and 1949, farmers in two adjacent areas organized the Seven-Eight and Eloy soil conservation districts, enabling them to get help with their conservation problems from the Soil Conservation Service and other agencies. Since the districts were organized, 26,377 acres of land have been leveled to desirable irrigation grade, and 244 miles of concrete-lined ditches have been installed on cooperators' farms with SCS technical assistance. Land leveling and ditch lining are two practices that show the most dramatic effect in saving water.

Typical of these farmers is Phil Thompson, who farms 1,620 acres of rich, loamy soil in the Redrock area. He has beeen a cooperator since the Eloy district was organized.

"We had to use water-saving practices or quit farming," Thompson said. "By leveling to a good grade, and according to soil type, and by lining ditches, we can double the acres of land we can farm with a given amount of water."

Thompson is a believer in planning his work and working his plan. Soon after becoming a district cooperator, he worked out a complete farm conservation plan with the help of technicians from the Eloy SCS office. His original plan, revised in 1955, called for reorganizing the size and shape of the fields, and for reducing their number from 15 to 9. He also planned to level each field and line all head ditches with concrete.

Thompson checks soil moisture with a soil tube before pre-irrigating for cotton.

He has kept his plan right on schedule, and planned to revise and improve it further upon its completion.

He had leveled 1,237 acres by mid-1961, moving a total of 413,787 cubic yards of earth, and had installed 8 miles of concrete ditches. Grades in the direction of run on leveled fields vary from 3 inches to 100 feet of row to $^6/_{10}$ inch to 100 feet. On some fields the last 300 feet of run is flat, to eliminate running tail water off the field.

Thompson uses his own equipment for land leveling. He has two rigs, a crawler tractor with scraper, and a large wheel tractor with scraper. He does most of his land

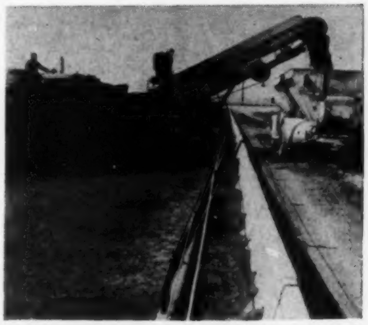
Note:—The author is work unit conservationist, Soil Conservation Service, Eloy, Ariz.

leveling during slack times, when tractors and men are not needed for other work on the farm. However, if he has a big job under way, he may keep at least one rig going even during rush seasons.

Thompson knows his water conservation practices would lose part of their effectiveness unless he also uses sound management practices on the land. His rotation varies somewhat, but is basically a 6-year rotation of 3 years of alfalfa, 2 years of cotton, and 1 year of small grain or sorghum. He says his cotton yields increased steadily from 1949 to 1957. The yields were "off somewhat in 1958 and 1959, but those were bad cotton years for everybody."

He returns as much organic matter to the soil as possible. All crop residues are returned to the soil. In addition, manure from about 1,500 head of steers fed in dry lot each year is spread on the fields. He also uses sound soil management practices. The soil is worked as little as possible, to reduce puddling and compaction. A subsoiler is used after leveling, and at other times when it is necessary to break up any plowpans that may develop.

Before planting, Thompson pre-



Thompson hires commercial specialist to spread barnyard manure.

irrigates to a depth of 4 to 5 feet, and tries to replace only the moisture removed by the plants during subsequent irrigations. He uses a soil tube or probe to check the depth and rate of penetration of water during irrigation.

Soil and water conservation go hand in hand in the entire Santa Cruz Valley area. Land leveling, ditch lining, conservation crop rotations, subsoiling, returning crop residues to the soil, contour irrigation, green manures, barnyard manures, and minimum tillage are practices used by nearly all farmers to get more efficient use of water and keep the soil where it belongs.

Slack-season land leveling to desirable irrigation grade on the Phil Thompson farm.

Chemicals Slow Evaporation

A mixture of hexadecanol and octodecanol has been shown to be effective in reducing evaporation losses from surface-stored water. Evaporation, the biggest single surface water loss in ponds, reservoirs, and lakes, may take up as much as 50 percent of the total water impounded during dry periods.

Formed from animal, vegetable, and marine oils, these chemicals are odorless, tasteless, and nontoxic to plant and animal life. They spread rapidly on water surfaces and form an invisible film one molecule thick.

These films were tested at the Texas Experimental Ranch in Throckmorton County during 1959 and 1960, in specially built twin ponds. In the 1959 tests, no decrease in evaporation resulted from applying the material in solid form, but the liquid form reduced evaporation an average of 17 percent. During periods of low wind velocity, daily savings of more than 25 percent occurred.

Liquid application has its drawbacks, however. If water should get into the application apparatus, or if the temperature should drop too low, liquid hexadecanol will crystallize. Further tests are being made to improve application methods and obtain more efficient distribution of the chemicals.

◆

On the Indiana State House grounds grows a red oak tree in a unique soil mixture—soil from the 400 farms of the supervisors of Indiana's 81 soil conservation districts. At the 1959 annual meeting of the State Association of SCD Supervisors, each district supervisor brought a sample of soil from his farm. The samples were mixed together, and on Arbor Day, April 14, 1960, the tree was planted in this mixture at a special dedication ceremony.

Water Conservation

A Key to South Dakota Progress

By Steve Kortan

WATER is big business in South Dakota. Our agriculture is keyed directly to the supply of water available for rapidly expanding irrigation, for ranching, and for dryland farming.

In some areas of South Dakota we do not have as much good water as we need for farming and other purposes. Some of our towns and cities seldom have a large enough supply in sight to relax their accustomed vigilance in its use.

The widening use of irrigation, coupled with conservation water management, is doing much to stabilize the farm output in South Dakota, with a steadying effect on the State's economy. Still, only 3 percent of South Dakota's farmlands are irrigated. A tremendous potential in our agricultural development lies not only in getting irrigation water to crops, but also in making efficient use of the moisture that is available to the rest of our crop and range lands.

Our precipitation ranges from an average of about 20 inches a year on the eastern side of the State to about 14 inches in the west. Unless effective water conservation measures are used, dryland farming stands to suffer accordingly in most years.

Out of a total of, say, some 18 inches of rain and snowfall on our croplands, only 3 to 4 inches of moisture is available for actual use by the dryland crops. The rest is lost through evaporation and runoff. About one-third of the rainfall comes as light showers which, because of high evaporation losses, are not effective in providing plant moisture. This and other evaporation losses account for about two-thirds of the precipitation.

A big opportunity in South Dakota agriculture clearly lies in the conservation of the nearly 80 percent of the rain and snow water not used by vegetation. South Dakota soil provides a tremendous reservoir for moisture. Experience of our farmers and ranchers over a half-century, and painstaking research by conservationists and other scientists have pointed the way to far more efficient use of moisture.

On our non-irrigated lands, the opportunity to do so lies in the use of those practices which (a) increase the intake rate of water by the soil, (b) store water by detention, and (c) tend to reduce the rate of evaporation.

Take terracing, one of our important water-conserving practices. We know from careful studies that this practice alone, on the basis of the storage of one additional inch of moisture, over the years can be worth approximately $4 an acre to the farmer growing flax, wheat, or soybeans, more than $5 an acre in the case of alfalfa, and $8 in the case of corn. This takes into account an average cost of terracing of $225 a mile, plus maintenance. Around 800,000 acres of cropland

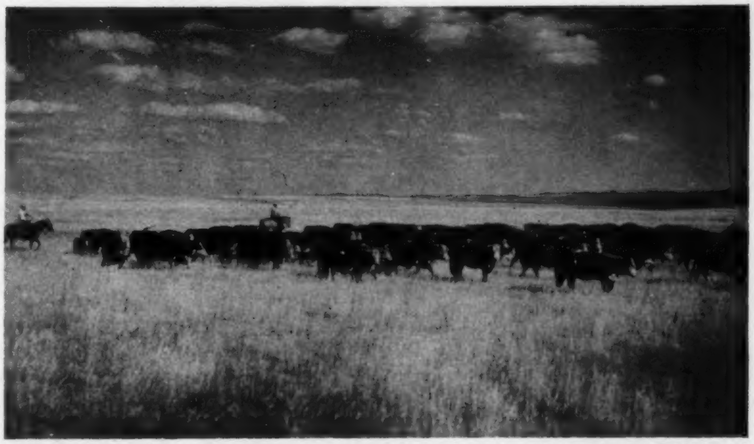
Note:—The author is State conservationist, Soil Conservation Service, Huron, S. Dak.

Conservation irrigation like this in Potter County, S. Dak., makes the best use of available water.

may be terraced profitably in South Dakota.

We also know that contour cultivation, which can be done for about $2 an acre, will store an additional acre-foot of water at a cost of about $14.50. Stubble-mulch tillage also belongs well up in the category of moisture-saving practices in importance. Stubble to trap additional moisture to improve the rate of moisture intake, to condition the soil for more efficient use of moisture, and to reduce evaporation is a tool the up-to-date South Dakota farmer is making sure is a part of his conservation kit.

There are other practices, of course, such as waterspreading, tree windbreaks, and the use of cover and soil-improving crops, which dovetail into this moisture-



Conservation grass management pays off for Raymond Sutton of Onida, S. Dak., in more pounds of beef to the acre.

Level terraces hold water for crop use on the Delmar W. Goddard farm near Onida, S. Dak.

Hay produced as a result of waterspreading with a terrace system on the Leo DeJong ranch in Tripp County, S. Dak.

conserving group. On rangelands, the principles of proper use similarly are tied in closely with the maximum use of rain and snowfall.

Added to these considerations are those involving the protection of our soil against erosion. Unrestrained by conservation practices, erosion takes its toll year by year in both soil and farm income.

The value to our agriculture and our economy of such water developments as the present Oahe Dam project on the Missouri River in central South Dakota is not to be underestimated. It is planned that Oahe waters alone will irrigate nearly half a million acres.

In irrigation farming, too, conservation management of water for top efficiency in its use is essential. This means using measures to prevent seepage and evaporation in the delivery of water to the land, the preparation of field surfaces to allow uniform water levels, and use of the best in farming practices to keep the soil in its most productive condition.

Experience has demonstrated that failure to use conservation measures in irrigation farming, on the other hand, means climbing costs, waste in water and soil, and declining yields. It means that an acre-foot of water stored in an Oahe will accomplish only half or less than its potential by the time its job is done.

Meanwhile, with modern technological and other conservation facilities available, farming areas outside the scope of such major irrigation projects need not remain static. A smaller per-acre investment in the known and tested practices in soil and moisture conservation will yield impressive returns. Soil conservation districts' programs and the Great Plains Conservation Program are geared to development of this potential; and cost sharing offered in the latter program and in the Agricultural Conservation Program makes it easier for landowners in nonirrigated areas to round out South Dakota's yet-to-be-completed progress story in stable and profitable soil and water conservation farming and ranching.

◆

Reports from 269 counties in the Great Plains showed that about 1,151,000 acres had been damaged by wind action as of April 1, 24 percent less than a year earlier.

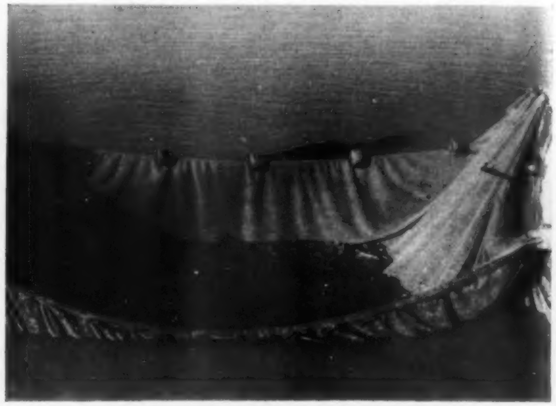
◆

An estimated 65 to 70 percent of the water now being diverted from streams for irrigation is actually lost to U.S. farmers.

75,000 Minnows An Acre

By James R. Cox

Two of the Garners' 35 minnow ponds.



A seine full of shiners to be graded.

Restocking refilled pond for next year's production.

Plant where minnows are sized and held for shipment.

LUTHER, Hugh, and Clyde Garner have made a profitable business out of raising "golden shiner" minnows in ponds developed on their farm in the Dallas County Soil Conservation District in southern Arkansas. They raise from 60,000 to 75,000 golden shiners an acre in an area where the average yield of cotton is only about half a bale to the acre.

Good management and scientific knowledge are musts for raising shiners successfully. So is a good market. The Garner brothers sell brood shiners as well as all sizes for fishermen.

The Garners built their first pond 12 years ago. They now have 35 holding and rearing ponds. Their water supply is a small, spring-fed creek that meanders across their farm.

Each winter, the ponds are drained, refilled, and restocked for the next year's production. The water is pumped into the ponds in the winter, when danger of contamination from fish eggs and small predatory fish is low.

Water is never wasted when a pond is drained; it is used to fill another pond that has been proper-

Note:—The author is work unit conservationist, Soil Conservation Service, Fordyce, Ark.

ly stocked. All the ponds are deep enough to take care of evaporation in hot weather. They are fertilized regularly in warm weather, and the minnows are fed daily the year around.

Disease and predatory fish and animals usually are among the hazards of raising minnows; but so far the Garner brothers have been able to control them. In fact, they have never been troubled by any of the common parasites found on shiners.

A plant the Garners built for grading the shiners includes metal vats that can hold a quarter of a million minnows for shipment.

Man K.O.'s Gully in Three Rounds

By George R. Smith and Grant Woodward

THIS is a blow-by-blow account of Leroy Marti's bout with a tenacious gully.

Marti and the gully practically grew up together, but he never felt that it had any right to be on the farm. The gully was born sometime after Marti's grandfather bought the place near Bern, Kans., in what is now the Nemaha Soil Conservation District. It started from a trail made by the cattle as they traveled from the barn across the railroad to the main part of the farm. It grew slowly at first; but as the adjoining grassland was plowed up and increased runoff water fed it, the gully's growth was faster with each rain.

When Marti and his wife, Mavis, bought the farm a few years ago, the gully had grown to be some 10 feet deep, and was a bully type that promised stiff opposition. Stiffer opposition, however, was what Marti had in mind. He and Mavis held a pre-fight conference to plan the attack. The farm buildings were begging for their limited money to be spent on them, but the Martis knew they had to whip the gully first. As Leroy put it, "You can always build buildings, but if you let your soil get away you are whipped."

They decided they needed a trainer; so they took the matter up with the Nemaha district supervisors. The result was a complete farm plan which Marti developed with the help of Soil Conservation Service technicians. The plan called for giving Mr. Gully his come-uppance.

A local contractor took the gully's measure and went to work with heavy equipment. But nature swung with an untimely assist on the gully's side. No sooner had it been shaped into seeming submission, seeded to bromegrass and redtop, and nearly counted out, than unusually heavy rain fell. Between 21 and 23 inches of rain belted the farm that August. When the rain stopped, the gully was revived to about where it was when the bout started. Round one went to the gully.

"Champ" Leroy Marti and Mrs. Marti.

Marti came back fighting. He gave the revitalized gully a thorough working over. He reshaped the waterway, and this time the bromegrass, helped by barnyard manure and commercial fertilizer, took over. All of the fight seemed to be gone from the gully as it became a 1,700-foot long waterway of gently sloping grassland, ready to make its own contribution in hay and grazing. Round two went to Marti.

Marti then was ready to terrace his cropland. The waterway by that time, he figured, could take care of any excess runoff. He finished the terrace system in 1957. The gully, however, still had fight. It took on new life beyond the farm boundary and began inching back past the fence line and into the "ring" again with Marti.

"It was growing at about 30 feet a year," Marti recalls.

An erosion-control dam then went into his conservation strategy. Marti himself operated a tractor as an employee of the contracting firm building the dam. There was satisfaction in helping to mold the structure according to the SCS engineers' design. It also was an extra punch at Marti's old foe, the gully.

The dam is about 50 feet inside the Marti property line. It has a pipe "riser" as a principal spillway, and a grass-protected emergency spillway. The principal spillway is 24 inches in diameter, large enough to handle the excess produced by the kind of storm expected about once in 5 years. The emergency spillway is designed for a 25-year frequency storm flow.

Note:—The authors are, respectively, State engineer, Salina, Kans., and engineer, Lincoln, Nebr., both of the Soil Conservation Service.

The erosion-control dam with which Marti finally knocked out the gully.

That third round, which went to Marti, seems to have been the decisive one.

Marti agrees it was quite a battle—but worth it. He has mastered erosion on the place. Farming is easier and a surer business. Marti's land now can make efficient use of whatever moisture he gets—whether too much, just enough, or less. Marti also has started catching some fish, as a satisfying added payoff from the water behind the erosion-control dam.

Owner Leroy Marti and SCS Engineer Clint Johnson examine fine grassed waterway that replaced the big gully.

Sprinklers More Efficient

Irrigation studies at the North Platte Experiment Station in Nebraska show sprinklers to be 15 percent more efficient in water use than gravity irrigation under controlled conditions.

The outstanding feature of a sprinkler system is better control of the amount and rate of water application. Other advantages include: Water can be applied more easily without eroding soil, allowing safe irrigation of sloping lands; water is applied uniformly on all types of soil, even those with high intake rates; less water is used, since deep percolation is reduced; no land grading is needed; more field area can be cropped—fewer field ditches and weeds; and leaching of fertilizers is lessened.

Automation has reduced much of the labor involved in using a sprinkler system.

◆

Farmers can save both labor and money by running their irrigation water through a screen to catch weed seeds. The seeds travel by water and will germinate after being in water for months or even years. Screening the water keeps weeds and trash out of supply ditches and cuts down the spread of weed seed on cropland, and delays the need for chemical weed control on new land. It also prevents trash from clogging siphons, spiles, pipeline valves, and sprinkler nozzles.

◆

Natural underground reservoirs in the United States store more water than all surface reservoirs and lakes, including the Great Lakes.

◆

Irrigation of farm crops takes about half of the fresh water used in the United States.

Problem Waste Water Turned Into Asset

By Oliver D. Jeffords

MANY an old irrigator has said, "I'm going to use that water till it wears out." That in effect is just what the Broadview Farming Company is doing on its mint lands north of Sunnyside, Wash., in the Roza Soil Conservation District.

Empty reservoir after wintertime removal of silt; pumping station in center and dam and mint still at left.

Broadview's circulating irrigation system, planned with the help of Soil Conservation Service technicians, came about from the practical necessity of putting available water to better use. More irrigation water could have been purchased, but the laterals didn't have the capacity to carry extra water to the fields fast enough. The limited-depth soils of the area dry out quickly and require light but frequent water application for the shallow-rooted mint crop.

It was found that a major part of the land could be made to drain into a gulch where a dam and pond already had been built. The pond provided water close at hand, but was below the irrigation pipelines already in use. The answer was to pump water from the pond through pipe connected with the irrigation pipelines, the pond acting as a settling or desilting basin.

Company land lies above the Roza gravity canal. Water is pumped first by the Roza Irrigation District and carried by a gravity lateral to Broadview's delivery boxes. It then is transported to the fields in a completely piped system, and continues down the individual mint furrows.

Tail water from the ends of the furrows flows in grade ditches to the 10½-acre-foot waste-collection pond. From the pond, water is pumped uphill again and returned through the pipelines serving as field headings, thus completing its closed circuit within the farm boundaries. Silt is removed from the pond during the winter months and hauled to nearby fields.

This repumping of irrigation water has proved to be a real conservation measure for the company. Water is better applied and adjusted to crop requirements, resulting in a more uniform crop. Soil and fertilizer are reclaimed and losses kept to a minimum. The system also does away with extensive drainage improvements or waste-water disposal off the farm, while offering protection to the adjacent, lower-lying lands.

"Re-using irrigation water turns a problem into an asset," Manager Carl Dunning said, "but there's a price tag to it."

He was referring to the \$16 an acre it costs the company for an estimated 2 acre-feet of re-used water, compared to the current basic water cost of the Roza Irrigation Project of \$10 for 3 acre-feet. Whether it pays to use waste water for irrigation within an irrigation project depends upon site conditions, crop returns, labor saved, and property valuation, factors that were carefully analyzed before deciding to go ahead with the Broadview system.

Reservoir which stores waste water for re-use on these Broadview Farming Co. mint fields and by the mint still.

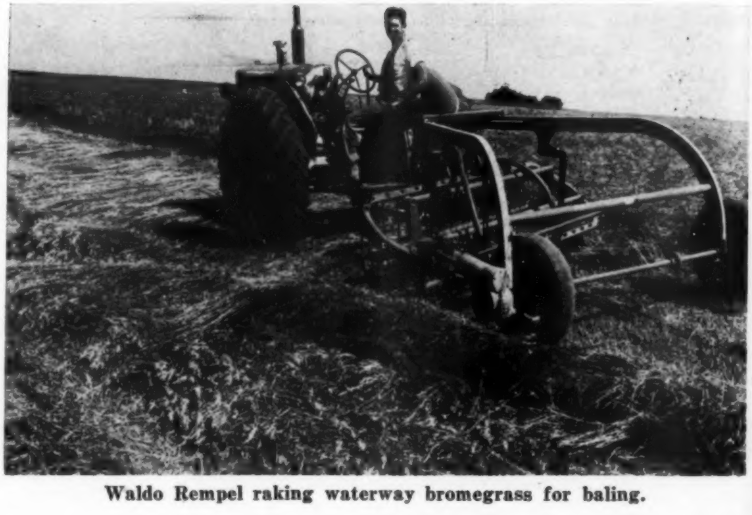
Note:—The author is engineer, Soil Conservation Service, Sunnyside, Wash.

Don't Pass Up a Good Bet

Harvest Those Grass Waterways

By Tom D. Dicken

KANSAS farmers who are not cutting hay from their grassed waterways perhaps can take a profitable tip from a growing number who are. The latter say they can't afford to pass up the chance to bale fine milk-, beef-, and mutton-producing feed from their waterway acres. Also, experience indicates that where tall and medium grasses are grown in the waterways, removal of the growth once a year is needed to permit proper water flow from terraces or other areas served.



Waldo Rempel raking waterway bromegrass for baling.

Take Orville Haury, former chairman of the Harvey County Soil Conservation District board, who started his waterways in 1949. He has increased his plantings to 12 acres of bromegrass waterways. Haury has harvested a seed or hay crop from them every year except two. The hay yields run from one to two tons an acre.

Haury has found it pays to apply 30 to 40 pounds of available nitrogen when waterway plantings are harvested for hay or seed. He gets hay approaching alfalfa in feeding value. He uses the hay in feeding his calves and in the ration for steers on full feed.

"I don't see why more farmers don't harvest their brome waterways," Haury says. "Anyone in the livestock business can always use hay. I doubt if over 10 percent of the waterways are cut in this county."

After 11 years, Haury's waterways show no evidence of silting or erosion, proof that harvesting grass from waterways is good for the waterways as well as profitable for the farmer.

Waldo Rempel, Arthur Unruh, and Paul G. Regier, close neighbors farming southeast of Newton, all have brome waterways which they harvest regularly, primarily for hay. They have completed most of their planned conservation practices, and all have received the Harvey County Bankers Award for conservation.

Regier has harvested his waterways 6 out of the 7 years since they were established. From 3 acres, he has baled between 2 and 2½ tons of hay an acre each year. He fertilizes with 100 pounds of 33-percent nitrogen every other year, and usually puts on barnyard manure in alternate years. He has found the bromegrass hay to be a palatable and nutritious cattle feed, ranking it between prairie and alfalfa hay in feeding value. But, Regier cautions, "Bromegrass hay should be well cured before baling. I believe this is the secret, along with early cutting, to getting good hay."

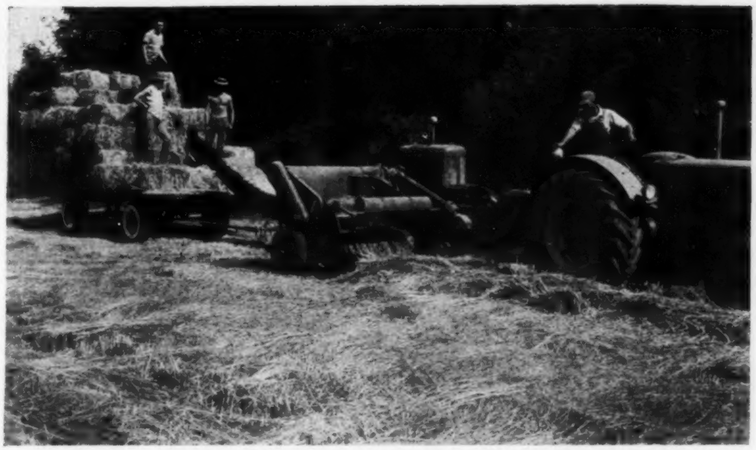
Unruh regularly cuts hay from his waterway. Average yield has been about two tons of good-quality hay an acre.

"I particularly like to use this hay to start feeding calves in the fall," he says. "It is better hay, cattle like it better than prairie hay, and it does not create the digestive disturbance alfalfa sometimes does."

He also finds that the brome responds profitably to nitrogen fertilizers.

"Before establishing my north

Note:—The author is area conservationist, Soil Conservation Service, Hutchinson, Kans.



Junior Snell (on tractor) baling native grass on Ross Ray's waterway.

waterway, there was a ditch which couldn't be crossed with machinery," Unruh added with respect to benefits. "Now the area is producing like the rest of the farm; and, in addition, it has enabled me to apply the needed conservation measures to the rest of the land to protect it from erosion."

Mr. Rempel, an active Harvey County district supervisor, has been harvesting hay or seed since his waterways were established in 1952. He considers them a productive part of his farm—"just like any other acre."

"The only thing wrong with waterways and terraces is that they are being established too late," he says. "They should have been installed when our forefathers broke this land from grass in the 1870's."

Several farmers in Reno County likewise have cut their waterways regularly for hay. Because bromegrass is not adapted to their soil and moisture conditions, native grasses such as switch, Indian, buffalo, little bluestem, and blue grama make up most of the grass cover. Yields have varied from 1 to 2 tons to the acre, depending upon the soil and rainfall.

Ross Ray has harvested hay from his 4 acres of waterways every year except one since they were established in 1950, getting almost 2 tons an acre in good years. His waterways are in excellent shape after 10 years. "I have found that in addition to getting a hay crop, the annual cutting seems to thicken up the grass and actually makes the waterway better," Ray explains. "Also, the removal of all that old growth leaves more space for the water to flow."

Junior Snell, who bales the hay on his own waterways as well as for his neighbors with his pickup, self-tying baler, will tell you that "Waterways are certainly not waste ground. In this country, where cattle feed is scarce, waterways can supply needed winter feed."

Terraces are one practice in a complete conservation program, and they need help to do their job. The type of terraces used in this area do not greatly reduce runoff, but they concentrate it at the terrace outlets. Some way must be provided to carry this water to the large, stabilized drainageways. Otherwise, terraces may increase gully erosion.

Native pastures are the ideal terrace outlet, but on the majority of Kansas farms it is necessary to use some additional method of water disposal for at least some of the terrace systems or diversions. This means grassed waterways on many farms. Usually every quarter section to be terraced will need from one to five acres of waterways shaped and established to grass before all the terraces can be built.

The 11 counties in south central Kansas need many grassed waterways, because of the large percentage of land in cultivation. Since farmers in these counties began organizing their soil conservation districts in 1943, almost 19,000 acres have been put into grassed waterways on nearly 8,000 farms, with the help of Soil Conservation Service technicians. Completion of the conservation job will require 40,000 more acres of these waterways.

Newly baled native grass on Kent Newcom's waterway in Reno County.

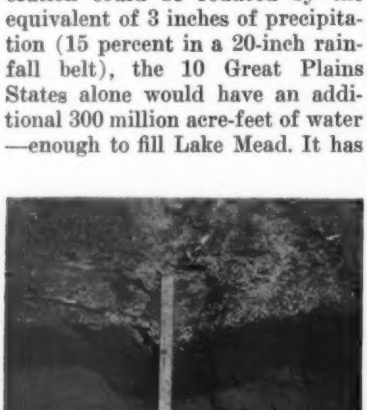
Soil Evaporation Is a Major Water Loss

By Omer J. Kelley

EVAPORATION of water from the soil surface is one of the main ways water is lost in any agricultural area.

It is estimated that of the amount of water that reaches the root zone under irrigated conditions, up to 50 percent is lost by evaporation from the soil surface. The problem is of equal or more importance on non-irrigated areas. For example, in the summer-fallow area of the Great Plains, it is estimated that at least two-thirds of the rainfall is lost by evaporation.

Studies have shown that if evaporation could be reduced by the equivalent of 3 inches of precipitation (15 percent in a 20-inch rainfall belt), the 10 Great Plains States alone would have an additional 300 million acre-feet of water—enough to fill Lake Mead. It has also been estimated that if evaporation from soil surfaces could be reduced by some 20 percent, it would practically eliminate the need for supplemental irrigation in much of the eastern part of the United States.



Soil moisture in normal field area (top) and (bottom) where ridges are covered with plastic.

Studies were made of the effects of varying amounts of plant water use on the yield of cotton at the Big Spring Field Station, Big Spring, Tex.; sorghum at the Central Great Plains Field Station, Akron, Colo.; and corn at the Northern Great Plains Field Station, Mandan, N. Dak.

The varying amounts of water available for plant use were obtained by the addition of irrigation water or the use of plastic materials to prevent evaporation of water from the soil surface. It should be pointed out that the research was conducted to study plant water use in relation to crop yield. While the increases in amounts of water indicated for plant use were not in all cases actually obtained by reducing evaporation from the soil surface, it is logical to assume that this could be brought about if ways could be found to reduce evaporation efficiently and economically.

The results for cotton in the southern Great Plains area showed that of 18 inches of water available, normal evaporation from the soil surface accounted for around 13 inches, and the plant used around 5 inches. Production of cotton was around 500 pounds of lint per acre. When 9 inches of water was available for plant use—and this could be obtained by a reduction of 4 inches in evaporation from the soil surface—then 900 pounds of lint was produced. When 13 inches of water was available for plant use, the yield was around 1,200 pounds of lint per acre.

In the central Great Plains area, 18 inches of water was available for sorghum production. When the plant used 5 inches and 13 inches were lost by evaporation, some 15 bushels of sorghum was produced. When the plant used 8 inches, 75 bushels of sorghum per acre was produced. When the plant used 11 inches of water, 100 bushels of sorghum per acre was produced.

At the Northern Great Plains Field Station, where the normal evaporation of the soil amounted to about 12 inches and the plant used 6 inches, 25 bushels of corn was produced per acre. Where plant use was 9 inches, 75 bushels of corn was produced, and when plant use was 12 inches, 100 bushels of corn per acre was produced.

No. 64

This is the sixty-fourth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

These preliminary and as yet unpublished data show the tremendous potential that is available, in terms of (1) reducing the amount of irrigation required to produce crops, and (2) increasing crop yield, either without irrigation water or with a limited amount of irrigation water. Scientists today do not know of any practical means of reducing evaporation losses from

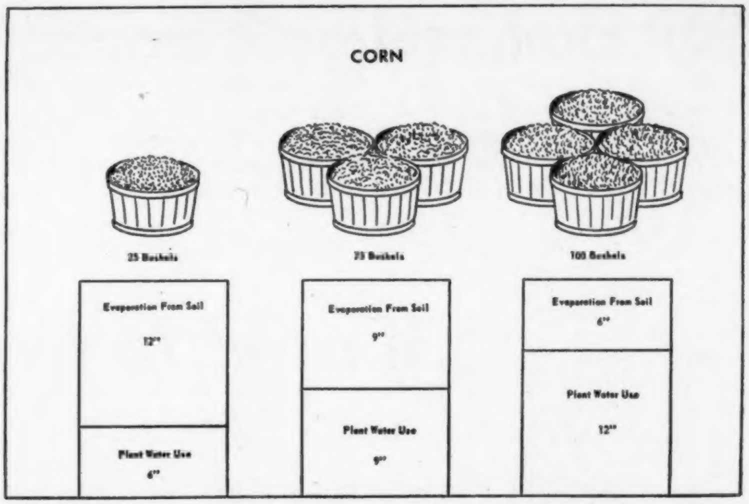
Note:—The author is Acting Chief, Northern Plains Branch, Soil and Water Conservation Research Branch, Agricultural Research Service, Ft. Collins, Colo.—From paper presented at National Water Research Symposium, Washington, D. C., March 28-30, 1961.

soil surfaces. There are, however, several methods that show promise from a research standpoint.

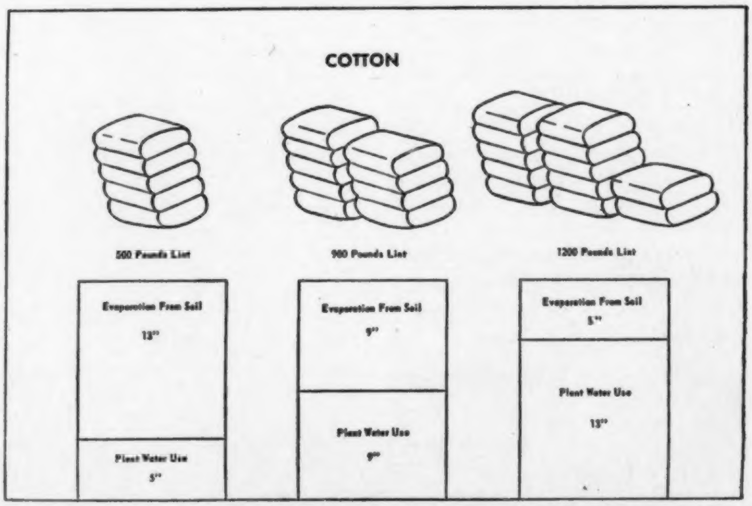
Various physical means show promise in reducing evaporation from soil surfaces. It is known, for instance, that the placing of gravel or coarse material over soil surfaces greatly reduces loss of water by evaporation. It seems possible through proper treatment that small clods could be stabilized and these could be used as efficiently as gravel or other coarse materials. It is possible that the small clods could be waterproofed so that water would immediately move into the underground portion of the soil reservoir. Then the clods would also serve in reducing loss by evaporation. Compaction of soil surfaces frequently reduces both intake rate and evaporation losses. A thorough understanding of the physical-chemical processes involved in soil compaction is needed before major breakthroughs will be made in this area.

The use of chemicals to reduce or prevent evaporation from soils also has great potential. We know, for example, that plastic films will practically eliminate evaporation losses.

In one field area, the ridges were covered with plastic to prevent water intake and to prevent evaporation losses, and another area did not receive the treatment. Under normal conditions, a ½-inch rain was rather uniformly distributed in the upper layer of soil. Most, if not all, of this water will be lost by evaporation from the soil surface. In the area where the ridges were covered, the moisture was concentrated in the furrow and reached a greater depth in the soil. Much of this water will remain in the soil and become available to plants after surface evaporation has been eliminated. Intensive research is needed to develop ways of obtaining deeper storage of soil moisture from small showers, so that evaporation losses may be reduced and more water made available to plants.



How corn yields increased as soil evaporation decreased at Northern Great Plains Field Station, Mandan, N. Dak.



Cotton yields went up as soil evaporation was lowered at Big Springs (Tex.) Field Station.

In irrigated areas, especially those producing vegetables and row crops, it is frequently necessary to apply several irrigations in order to get seeds germinated and a stand established. Much of the water is lost by evaporation. If some means could be developed whereby the seeded area could be covered to reduce evaporation and maintain a high moisture content, then irrigations normally used for seedling emergence and establishment could probably be eliminated. Excellent stands of grass seed, sugarbeets, and sweet corn have been obtained by using plastics over the planted area. This, of course, is not a practical method at the present time, but it does show the tremendous

potential for saving water if research can find practical and economical methods and materials.

What we need, perhaps most of all, is an understanding of the atmospheric environment and the soil environment as they affect the evaporation and use of water by plants. We don't know nearly enough about the single or interacting effects of wind movement, relative humidity, temperature, and light intensity on the evaporation processes and the use of water by plants. At the present time, to my knowledge, there are no facilities in the world that will allow for the study of these effects at various levels and in combination with each other. We are also still uninformed regarding many aspects of soil structure and dynamics of soil water as they affect evaporation of water from the soil surface.

Water Is Gold

To California Rancher

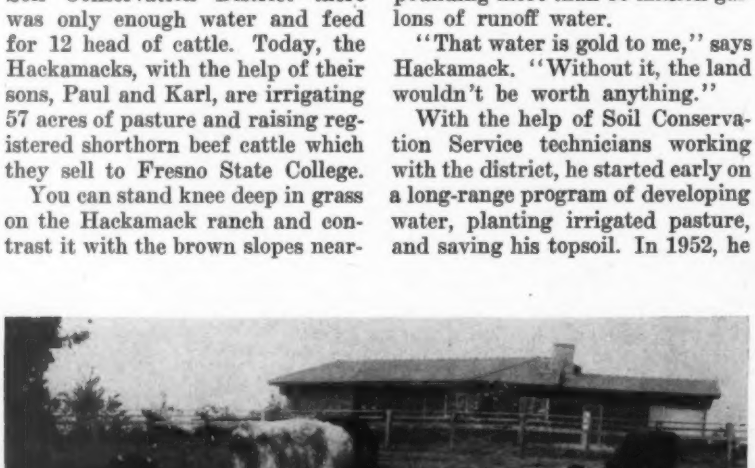
By Homer W. Marion

WHEN the John Hackamacks bought a 120-acre ranch in the Pajaro Valley in the Pajaro Soil Conservation District there was only enough water and feed for 12 head of cattle. Today, the Hackamacks, with the help of their sons, Paul and Karl, are irrigating 57 acres of pasture and raising registered shorthorn beef cattle which they sell to Fresno State College.

You can stand knee deep in grass on the Hackamack ranch and contrast it with the brown slopes nearby. John expects to carry about 75 head of breeding stock when the ranch is in full production, by impounding more than 30 million gallons of runoff water.

"That water is gold to me," says Hackamack. "Without it, the land wouldn't be worth anything."

With the help of Soil Conservation Service technicians working with the district, he started early on a long-range program of developing water, planting irrigated pasture, and saving his topsoil. In 1952, he dammed up a ravine and formed a reservoir that holds 44 acre-feet of water. He also received help through the Agricultural Conservation Program.



Registered shorthorns on irrigated pasture near the John Hackamack home.

The job involved bulldozing out timber and willows and building a dam with carryalls. The reservoir captures and holds runoff water from the hills, which otherwise would flow out to sea and be wasted.

The dam is $18\frac{1}{2}$ feet high and has nearly 6 surface acres. There is a concrete chute-type spillway on the west side of it to take care of excess water. After one heavy September downpour, the dam filled to near capacity from only 4 feet of water. There also are springs feeding this reservoir, and subirrigation in some of the pasture below it.

Three years later, Hackamack built a 10-acre-foot reservoir on top of a hill. When the reservoir behind the dam is filled, he pumps the excess water to this reservoir. The combination of the dam and the hilltop reservoir enables him to irrigate 35 acres of pasture.

A second dam, fed by two ravines coming out of the foothills,

Note:—The author is work unit conservationist, Soil Conservation Service, Watsonville, Calif.

This 18½-foot-high dam built in 1952 stores 44 acre-feet of irrigation water.

was finished in the spring of 1957. It is 23 feet high, also has a concrete spillway, holds 40 acre-feet of water, and irrigates 22 acres. A portable pump is used to sprinkler-irrigate several pastures from both dams.

Hackamack stocked the first dam with large-mouth bass, bluegills, and crappie. The second is stocked with channel catfish. Fishing is excellent, and he personally invites friends to come and enjoy the sport. He also keeps a flock of geese in the reservoir to keep down the growth of tules.

During the late fall, winter, and spring months, he runs his cattle on dryland pastures on the ranch. They are not allowed on irrigated pastures during wet months, because their hoofs would tear up the soil and trample grass into it, doing more harm than good. Cattle likewise are not allowed to graze the grass too closely.

In 1955, Hackamack received a certificate of merit for outstanding accomplishments in soil conservation, on the recommendation of the Pajaro SCD.

"Some of my land could be used for row crops," Hackamack said. "However, most of it is rolling hill land, and I feel that from a conservation standpoint it is best suited to irrigated pasture."

Flood Problem Solved By Group Action

By D. C. Hadfield and Alvin Kranzler

HEAVY runoff from Houtz Canyon plagued the members of the West Ditch Irrigation Company in the Rockland Valley of Idaho for many years. The runoff meandered through dryland fields on the west side of the county road. A large amount of silt-laden water and debris bypassed the road culvert, sometimes washing out the road and the irrigation canal on the east side of the road, flooding ditches and fields and often causing severe damage to crops.

The West Ditch Irrigation Company of Rockland is a nonprofit organization owned and controlled by eight farmers. It provides water for approximately 450 acres of cropland. Disruption or interference in the flow of water had an adverse effect on the crops grown—and cost the farmers plenty.

In the spring of 1958, officers of the company recognized that help was needed to solve the problem and contacted Soil Conservation Service technicians assisting the Power Soil Conservation District. The SCS personnel made the necessary surveys, designs, and specifications for the project. They referred the officers of the ditch company to the Power County ASC office, where Agricultural Conservation Program payments were explained and applications were made prior to the start of construction.

The surveys and plans of action resolved by the West Ditch Company, County Commissioners, County Road Supervisor, the ASC, and SCS personnel, indicated that the following steps should be taken to solve the problem:

(1) Runoff from Houtz Canyon had to be properly channeled and

Note:—The authors are, respectively, work unit conservationist, Soil Conservation Service, and Power County ASC Office Manager, both of American Falls, Idaho.

A group inspects the grassed waterway that carries floodwater from Houtz Canyon to Rock Creek.

Group inspection of rock riprap where the grassed waterway from Houtz Canyon enters Rock Creek.

controlled on the west side of the county road. The roadbed had to be graded up and a bridge built to replace the culvert. The County Commissioners and Road Supervisor agreed to, and did, complete this project at their expense of approximately $1,260.

(2) The irrigation system had to be reconstructed by realigning the existing canal adjacent to the east side of the county road and installing a buried 96-foot-long, 24-inch concrete pipeline with proper end structure. In this way the irrigation water is carried under a grass waterway on the east side of the county road. This portion of the project involved considerable expense and engineering services. Officers of the irrigation association applied for ACP cost-sharing under a pooling agreement. The Federal cost-share approved was 50 percent of the cost of excavation, installation, and materials, which added up to $572.52.

(3) A waterway was established from the east side of the county road to Rock Creek to dispose of runoff passing under the bridge. This work was done, along with an ACP land-leveling practice, by an individual farmer.

The total cost of the entire project was more than $2,500; but the project and its obvious future benefits created so much community interest that donations by neighbors and local citizens reduced the actual cash outlay. For example, the grass seed and seeding of waterways was donated by individuals, as was the riprapping.

The multiple benefits from this project become more manifest each year. Officers of the irrigation district explain that the most obvious benefits are these: (1) The grass waterways convey the formerly damaging runoff into Rock

Melvin McLain (left) and Harold Permann watch irrigation water flow from the outlet of the 96-foot underpass of the grassed waterway that carries floodwater from Houtz Canyon.

Creek, where the water can be used beneficially downstream. (2) The county road, used by many people, remains in good condition at all times. (3) Crops in the valley no longer are destroyed or damaged by floods and silt deposits. (4) Farmers directly affected by the irrigation system indicate that efficiency has been increased immeasurably, and maintenance costs reduced by some 80 percent.

Specialized Water Forecasts Promising

By Homer J. Stockwell

MORE specialized streamflow forecasts are being made by Soil Conservation Service snow surveyors in the West to give irrigators more precise information as to when they may expect peak and other predetermined flows during the cropping season.

Promising results have been obtained during the past few years in which this type of forecasting has been under development, as confirmed by the experiences of water users in the watersheds involved. They report having been better able to adjust their cropping systems to obtain maximum efficiency of water use.

The principal use of mountain snow measurements has been to forecast total streamflow during the irrigation season. This past season these forecasts were made at some 600 gaging stations in 11 States.

Forecasts of flow for the season have been adequate for water users' needs where enough reservoir storage is available to spread the peak flows of May and June over the peak demands for irrigation water of July, August, and September.

Note:—The author is soil conservationist, Soil Conservation Service, Portland, Oreg.

If the total streamflow is to be more or less than normal, the user knows he will have to adjust his crop acreage or demands accordingly.

Although more reservoirs are being built every year, there still are many irrigated areas without storage. Crop production is limited by the flow of streams during July and August where water is available only from direct diversions, and to forecast the amount or timing of the low flow of a stream requires considerably more detailed study of a watershed than to forecast the irrigation season's flow.

SCS snow surveyors measuring snow depth and water content.

The basic information required includes not only snowpack measurements and related hydrologic data, but also information as to water rights, local irrigation practice, and detailed records of diversions and water use.

In recent years, SCS technicians associated with snow surveys and water-supply forecasting have cooperated with irrigation district management and water users associations to develop forecasting procedures for various aspects of the low-flow hydrograph of streams.

At the April 1961 Western Snow Conference at Spokane, Wash., these problems were discussed by a panel of water managers and snow-survey supervisors. Representative of the problems and forecasting methods were those reported for the Sevier River Basin in Utah, the Carson Valley in Nevada, and the Grants Pass Irrigation District served by the Rogue River in Oregon.

President Leland C. Callister of the Sevier River Water Users Association, Delta, Utah, described the complex system of water rights in four or more irrigated sections of the Sevier River Basin. The most important forecast for the water users is one that enables them to know in advance the approximate dates during which their full primary water rights will be available, and then to know what percentage of their primary rights will be available for the remainder of the irrigation season. These primary rights total from 90 c.f.s. to 400 c.f.s. for the various irrigated sections of the basin. There is some storage on the river, used principally to capture winter flows and the top of peak flows during recently rare high-runoff years. Most years there is a deficiency of streamflow for demands.

Forecasting of the Sevier River requires a detailed study of snow accumulation and melt, groundwater carryover, return flow, low to intermediate elevation precipitation, soil moisture conditions, and a thorough knowledge of the sources of water for each irrigated section of the river. The upper sections of the river are most affected by the current year's snowmelt runoff, while the flows in the lower sections are more affected by groundwater carryover and return flows from upstream diversions. Forecast techniques make use of the above factors in several combinations, depending upon their relative importance for each irrigated section.

Because good records are available for most of the Sevier River Basin, it has been possible to develop at least seven special forecasts within a reasonable degree of accuracy. These include dates at which the streamflow will fall to a specified flow in c.f.s., the percentage of primary rights to be available, and the acre-feet of flow in excess of the normal diversion demands in c.f.s. that may be available for storage during the peak of

Mountain snowfall is the major source of irrigation water in the West.

snowmelt runoff.

William Johnson, Carson Valley Soil Conservation District rancher, reported that the critical low flow of the East Carson River near Gardnerville, Nev., was 200 second-feet. This amount of water will satisfy water rights of a priority before 1900. Water rights granted since that date are considered as flood rights and do not share in any flows below the 200-c.f.s. level. The forecast of the date of the decline of streamflow to this level is particularly important to "flood rights" users, because they will not have water available after that time.

The low-flow date of the East Carson River is forecast almost directly from measurements of mountain snowpack as of April 1 and May 1 each year. After the snowmelt peak has occurred, a forecast is prepared based on a multiple correlation of the amount of the peak flow and the number of days after April 1 that peak flow occurs, to that of the date of 200-c.f.s. flow. The peak flow usually occurs in mid-May, but may occur as early as mid-April and as late as mid-June.

Use of spring precipitation and temperature factors in the procedure is planned, and should increase the accuracy of the forecast. Forecast accuracy improves as more data become available. April 1 forecasts of the date of 200-c.f.s. flow made 6 to 12 years ago did not represent much improvement over simply forecasting the average date. Recent procedures have resulted in forecasts much closer, one-half of the error (in days), than if the average date for the flow of 200 c.f.s. had been selected. After the peak flow has occurred, the average error in the date of forecast is 4.7 days. The typical forecast is made 53 days before its occurrence.

Johnson said that during years of poor water-supply forecast, oats usually are seeded as a hay crop early in March, so it can mature before the streamflow drops off. Seeding of new alfalfa or pasture is avoided. The planting season plans thus are regulated by water supply predicted for the growing season.

Manager Neal F. Shaffer of the Grants Pass Irrigation District pointed out that flows of the Rogue River at Savage Rapids (Diversion) Dam under 900 second-feet are not adequate to meet all district demands. Minimum flows of 900 second-feet or less have occurred in only about 15 percent of the past 50 years, but it is important to know each year whether this will happen. When this low flow does occur, it is necessary to place canals in rotation.

Planning crop acreages in line with water-supply forecast helps farmers avoid crop failure like this.

The forecast of the minimum flow of the Rogue River is well related to April 1 snow measurements in the watershed. In 31 years available for comparison, the standard error of estimate is plus or minus 183 c.f.s., based on a mean of 1,077 c.f.s. A secondary effort to forecast the date of minimum flow shows that considerable improvement can be made over simply using the "average date" in low-flow years after the 200-c.f.s. date on a receding hydrograph is known. There is an average of 58 days between the 2,000- and 900-c.f.s. levels.

The low flow of a snowmelt stream in any year is determined largely by the amount of the seasonal snowpack and the related volume of seasonal runoff; the temperature sequence, related to the amount and timing of peak flow; and precipitation during the runoff season immediately preceding and during the period of low flow.

The amount of the seasonal snowpack is the major determining factor that is known well in advance. Because the temperature and precipitation factors occur within the runoff season, their value is limited to refining forecasts as late as June 1 or possibly July 1. Even this late, farmers can withhold water from such crops as alfalfa and pasture and concentrate on field crops which would be a complete loss, if late-season water supply appears to be somewhat less than anticipated earlier.

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Water quality determines the worth of water for a particular use. Some water is suitable only for fighting fires or washing streets. Other water is of excellent quality and in great demand.

◆

For a 30-year period the Missouri River at Bismarck has had an average flow of 21,240 cubic feet per second, or 15,380,000 acre-feet a year. The flow has ranged from an extreme of 1,800 cubic feet a second to 500,000 cubic feet a second.

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We can live longer without food than we can without water.

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"As the total demand for water increases and as the competition among uses becomes more intense, it seems certain that society will not tolerate inefficiency in use."

—*Dr. Roy Huffman*
Montana State University

Water Management Remakes Muck Pasture

By C. F. Lind

An effective conservation water management system has enabled L. Neal Smith of Montverde, Fla., to double the number of cattle on his muck-land pasture. Smith also is a citrus grower and is a cooperator with the Lake Soil Conservation District. He has been fighting the natural elements for years, particularly in developing and using his muck pasture.

"I'm never completely happy," is the way he puts it. "When we don't get any rain my groves suffer, and when we get too much rain, my muck farmland and pastures are too wet and I can't get on them."

His approximately 400 acres of old muck pasture is surrounded by higher, sloping sandy soils. Highland citrus groves virtually surround the muck area, with Lake Apopka on the east. The lake level is 2 to 3 feet higher than the average muck elevation. Consequently, there were two main problems to be solved. The first one was to keep Lake Apopka water out; the second, to divert and get rid of seepage water from the surrounding higher land.

When Smith came to the SCD office for help, he already had a dike constructed to hold back Lake Apopka; and a main canal through the middle of the muck area, plus a number of lateral ditches, had been dug. A pumping station with one 30,000-g.p.m. low-lift pump and two smaller automatic electric pumps were installed. The pumps are more than adequate to control the seepage water, but water was not draining out of the muck fast enough during and after rains, leaving large areas impossible to work for long periods.

"I've already spent thousands of dollars, but so far it's been almost a losing battle to control the water," Smith said. "I want your help—whatever you say will be done."

Soil Conservation Service technicians assisting the Lake SCD made a preliminary check of the entire area, making borings to check soils and water levels to establish the feasibility of a more complete water-control plan. Next, a complete topographic survey map was made.

Muck areas usually are level, but Smith's muck land varied in elevation as much as 5 feet. The proj-

Owner Neal Smith (left) and C. F. Lind of the SCS look over cattle on improved muck pasture.

Note:—The author is conservation aid, Soil Conservation Service, Tavares, Fla.

Automatic pump station with 42,000-g.p.m. capacity removes seepage and floodwaters.

ect accordingly had to be divided into separate water-control areas, with all outlets leading to the main discharge canal and drainage pumping station. A complete water-control system for drainage and irrigation was designed and laid out.

A few lateral ditches were relocated, others had to be extended, and 12 more laterals were constructed. Grade- and water-control structures were installed in laterals for water control and irrigation purposes. These structures also are used as bridges in the farm road layout.

Irrigation water is supplied by wells at various points of higher elevation throughout the area. Nine hundred feet of 6-inch tile was installed in one area, to intercept seepage from higher ground and thereby remedy the wet condition of one particularly troublesome area.

Benefits from the new-water disposal and irrigation system are threefold. Excess water is now removed and all the muck areas made accessible in a few days. Smith's

Lateral ditch in Neal pasture with citrus orchard beyond.

300 head of cattle now find good grazing in the pasture-rotation system. He harvests silage twice a year from such crops as oats, millet, and fescue, with yields of up to 7 tons an acre from each cutting.

Those are reasons why Smith says he is pleased with his water-control system and that the money spent was a good investment.

WATERSPREADING

Puts More Raindrops to Work

By Herbert I. Jones

LAST summer when things were dry in western North Dakota Kermit Perhus was getting a second cutting of hay where once only sparse grass grew.

Key to Perhus' success is a spreader dike system he built to guide hill runoff onto lowland grass. The result has been early spring grazing and hay when other ranchers in the neighborhood have reported dwindling feed.

The Perhus ranch near Marshall is small as ranches go in that area, and a grass failure on a small ranch can spell disaster with a big "D." Perhus cut the chance of failure by, as he puts it, "making every drop of water count." At the same time, Perhus' upland range is in better shape than ever—cushioned by the abundant hay.

The change that made all this possible began about 10 years ago when Perhus tired of watching runoff sweep by grass thirsting for a drink. He had read about waterspreading work in other areas.

Soon, with the help of a neighboring soil conservationist, Perhus worked out the system of ditches and dikes to divert channeled water back onto the flats. As a result, he was able to grow 100 acres of native hay—no small item on a 2,500-acre ranch. Since then, by planting tame grasses in disturbed areas, Perhus has increased the hay land to 200 acres and also increased the tonnage.

Perhus learned in the first few years that mother cows could be kept on the meadows until late June without reducing hay yields. Summer feed thus saved has meant better management of the native range as a bonus.

By 1952 Perhus was, as he says, "at it again—putting more raindrops to work." That year he built dikes with the Dunn County Soil Conservation District's terrac-

Note:—The author is information specialist, Soil Conservation Service, Denver, Colo.

Jeanette Perhus likes to ride her quarter horse and help her father check his Circle Cross herd on his 3,000-acre range of good to excellent native grass.

ing equipment. It was the first time the cropland equipment had ever been used on range work. Later on he used motor-patrol graders.

Almost every year since then, Perhus had added to the system of dikes crossing his lowland range. End-to-end, the segments would total around 8 miles—and there is more dike work slated on the Perhus calendar.

He likes to build his spreader dikes so they settle solidly to a 2-foot height. If dikes are wide enough, he points out, you can mow right over the top when you decide to cut hay. He suggests from 30 to 40 feet for the bottom width.

Perhus plows and seeds oats, alfalfa, and bromegrass in the spring after a new set of dikes is established. Before long the grass "catches." Yields of up to 2 tons of hay to the acre are common after that. Counting the grass harvested in early spring grazing, Perhus figures he is getting up to 4 tons of feed to the acre off of the watered part of his place. Yields have been good enough, he reports, to pay for each set of spreaders within a couple of years.

Perhus' better water utilization and hayland improvement have spelled a big difference on the family ranch. His breeding herd has been brought up to 125 Hereford cows, and his range is in better shape than ever. A wildlife crop —deer, pheasants, grouse, and partridge—lives off the bounty. Local friends know the Perhus ranch as a hunter's paradise.

Perhus was recognized for his ranching success a year or so ago when he was named winner of the Liberty Bank trophy for the year's best pen of yearlings. Enabling him to win were good breeding matched with range management, plenty of hay from the waterspreading area, and some silage and grain from his 120-acre corn field.

Along with Perhus' livestock and feed production interest has been his concern for soil and water development and conservation. He has a complete conservation ranch plan worked out with the help of Soil Conservation Service technicians assisting the Dunn County district. The waterspreading work is only a part of his soil and water conservation system. He now has adapted his plan to the Great Plains Conservation Program.

Flourishing mixtures of tame grasses and legumes along Perhus' new spreader dikes eventually will be taken over by spreading native grasses.

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Tests conducted by two Nebraska scientists show that it is practical and feasible to utilize grass waterways for the disposal of irrigation waste water as well as high-velocity rainfall runoff.

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The Great Lakes contain the world's largest supply of fresh water—6,700,000,000,000,000 gallons.

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Teacher and Conservationist

"A PROPHET is not without honor save in his own country" does not apply to F. E. DuBose of Gable, S. C.

Reared in the East Clarendon School District No. 3 of which he is superintendent, he holds or has held numerous other positions of leadership and responsibility, including being a supervisor of the Clarendon Soil Conservation District for all but about two years since its organization. He has served as teacher, coach, principal, and superintendent for a total of 32 years.

The district supervisor job is non-salaried, as are most of the positions he has held. DuBose figures that his pay is service to his fellow man. This is how he describes it:

"You can ride along the road and see that the panorama has been changed by efforts of the Clarendon Soil Conservation District. It has improved the economy of the county by improving production on land once low in production. The Long Branch ditch revolutionized farming in the community. A preacher remarked to me recently, 'I have never seen a community develop like Barrineau Crossroads Community.' Soil and water conservation and proper land use are a big factor in the improvement of economic conditions in this community and throughout our soil conservation district."

Supt. F. E. DuBose (left) and John M. Dukes of the SCS discuss teaching of soil and water conservation.

DuBose is president of the South Carolina High School Athletic League, a member of the South Carolina Advisory Council on Conservation Education, and past president of the Clarendon County Educational Association and of the South Carolina Elementary Principals Association. Getting conservation taught in schools holds his special interest.

"My observation is that teachers have a desire to teach conservation by relating it to subjects taught," he says. "But, they don't have the know-how in all cases. They need more material and training related to teaching conservation of soil, water, woodlands, and wildlife."

DuBose is president of the Clarendon County Chamber of Commerce, county Farm Bureau director, president of Ruritan, vice president of the Pee Dee Area Council of Boy Scouts, elder in the Sardinia Presbyterian Church, first vice president of the Clarendon Tuberculosis Association, and chairman of the Camp Harmony Committee, and is on the board of trustees of Clarendon Memorial Hospital.

Positions he formerly held included those as: President of the Clarendon County Farm Bureau and State Farm Bureau director, chairman of the South Carolina Agricultural Committee, president of Men of the Church for Harmony Presbytery, and National Democratic Convention delegate.

DuBose's philosophy: "I like to see a man proud of the place where he lives, and to see a man so live that his place is proud of him.

—J. B. EARLE